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AUTHOR Davenport, Linda Ruiz; Sassi, Annette
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ABSTRACT

This paper examines the reactions of 10 elementary teachers to a teaching case used as part of a professional development project's curriculum. Their written reactions to both reading the case and participating in a 2-hour discussion of it suggest that cases may stimulate teachers to think about their own understanding of mathematics, the mathematical thinking of children, and their roles as teachers. In addition, patterns in the data suggest that teachers' reactions to cases are strongly colored by their prior experience with case materials, their abilities to articulate the subtleties of reformed mathematics teaching practice, and where they are in their thinking about mathematics education reform. Contains 17 references. (Author)

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RAISING VOICES: USING TEACHING CASES TO STIMULATE TEACHERS' THINKING AND REFLECTION IN MATHEMATICS EDUCATION

Linda Ruiz Davenport, Education Development Center
Annette Sassi, Education Development Center

This paper examines the reactions of 10 elementary teachers to a teaching case used as part of a professional development project's curriculum. Their written reactions to both reading the case and participating a two-hour discussion of it suggest that cases may stimulate teachers to think about their own understanding of mathematics, the mathematical thinking of children, and their roles as teachers. In addition, patterns in the data suggest that teachers' reactions to cases are strongly colored by their prior experience with case materials, their abilities to articulate the subtleties of reformed mathematics teaching practice, and where they are in their thinking about mathematics education reform.

The current mathematics education reform recommendations call for a practice that is different in kind from what we see in most classrooms today (Cohen et al., 1992; NCTM, 1989, 1991; NRC, 1989; Nelson & Hammerman, in press). Adopting a practice consistent with these recommendations requires developing a deeper understanding of mathematics, a new sense of what it means to learn mathematics, an appreciation of the mathematical thinking of which students are capable, and a sense of the mathematical tasks and investigations that support the development of powerful mathematical ideas.

Many teachers lack rich images of what this new mathematics teaching practice might be. They themselves did not learn mathematics this way, and many of them were not prepared to teach this way in their teacher education programs (Ball, 1988). Furthermore, the relative isolation of many teachers has resulted in few opportunities to visit innovative classrooms, even when these innovative classrooms exist (Ball, 1994; Barnett & Tyson, 1993).

Increasingly, teaching cases are proving to be a powerful vehicle for communicating possible visions of mathematics education reform. Cases provide situated images of this new pedagogy, allowing teachers to analyze its subtleties and complexities in classroom contexts (Barnett, 1991; Carter, 1993; Shulman, 1986; Shulman, 1992; Sykes & Bird, 1992; Witherall & Noddings, 1991). Cases help teachers learn to articulate the dilemmas of their own practice, thus helping them learn to voice their own perspectives, issues, and concerns (Schifter & Fosnot, 1993; Schifter, 1994). Furthermore, teaching cases help teachers learn to establish collaborative norms for thinking about, and talking about, their mathematics teaching practice (Featherstone et al., 1993).

Unfortunately we know little about the images that individual teachers create from these case materials. Nor do we know very much about differences between the understandings they construct from reading case materials, and what they further gain from participating in a structured case discussion. This paper explores what individual K-8 teachers in a professional development project seem to gain

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from reading a teaching case and then participating in a discussion about it with colleagues and a facilitator.

The Teachers

The teachers in this study were participants in the Teachers' Resources Network (TRN), a project designed to help K-8 teachers transform their mathematics teaching practice through the exploration of the resource materials currently available to the mathematics education community. These teachers met biweekly after school with a project facilitator and were encouraged to explore and discuss resource materials of particular interest to them.

Several teachers were very new to the teaching profession, and others had been teaching for over 20 years. They came to the project with a range of prior professional development experiences and were concerned about a wide range of teaching and pedagogical issues.

The Case and the Case Discussions

While most TRN meetings focused on resources that teachers selected, on two occasions the facilitator structured a whole group discussion around a teaching case that she brought to the group. This paper focuses on the first of these teaching cases, which was explored over a period of a month[1] last winter. The case, entitled *Inside Student Thoughts: Take One-Third*, is from a recently-published casebook in mathematics education (Barnett et al., 1994). It begins with a teacher posing the following mathematics problem to a group of 7th- and 8th-grade students: *On your own, draw a picture where you take 1/3 of 1 1/3. Hint: Start with a picture of 1 1/3.* The case then explores how students thought about this problem, how the teacher reacted to their thinking, and what the teacher thought about her lesson.

Prior to receiving a copy of the case, teachers were given as homework the fraction problem posed in it, worded exactly as it was in the case. They came to the next meeting prepared to discuss the problem, and were eager to share their thinking. Many said they also had posed the problem to friends, family, and even their own students. The discussion took most of the three-hour meeting. At the end of the meeting, the teachers were given a copy of the case and asked to read it and write their reactions for the next meeting.

The next three-hour meeting was dedicated to discussing the case itself. The conversation revolved around several main issues[2] : (1) what was difficult conceptually about the problem; (2) what role did language play in confusing or

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[1] The discussion of the case actually continued for more than a month. Teachers continued to think about it, referred to it in many subsequent meetings, and one teacher even brought in student responses to the problem posed as late as the May meeting. However, only two meetings were specifically set aside to discuss the case with the group.

[2] The discussion was facilitated by the TRN project director, who used teachers reactions to the case as a starting place for the discussion. The description of the issues is couched in their terms.

enlightening students about how they might solve the problem (e.g. how were students to know that "of" meant multiplication); and (3) to what extent was the teacher in the case intending to allow her students to "explore" and to what extent was she actually trying to "teach" them. These last two issues had been raised explicitly in the case by the teacher herself. During the last 20 minutes teachers were asked to write additional reactions or insights that came as a result of the discussion.

We then analyzed the teachers' written reactions, looking for patterns across a set of 10 reactions written after reading the case but before the case discussion, and a set of 9 reactions after the case discussion.[3] These patterns are described below, along with excerpts of the actual writing of these teachers, used with their permission and identified with their initials.

Teachers' Reactions After Reading the Case

Reading the case did evoke for teachers images about the complexity of teaching. Their initial reactions to the case explicitly referred to several challenges often faced as teachers reconstruct their mathematics teaching: (1) confronting the limits of their own mathematical knowledge; (2) confronting children's mathematical thinking and reasoning; and (3) questioning their roles as a teacher.

Some teachers wrote about recognizing the limits of their own mathematical knowledge. Some expressed reassurance that they were not alone in their struggle to deeply understand the mathematics content. For instance, MMC wrote: "Maybe she [teacher in the case] has a hard time conceptualizing as I do." Others couched their awareness in more anxious terms. FCA wrote: "But how am I going to make sense of that to my students? How am I going to make sense of that to *me*?" YRC confided that she made the same mistake as one of the students in the case and then questioned "Why *is* it OK to divide in order to multiply?"

Some teachers thought about children's' mathematical thinking, often in connection with the confusing nature of the content. MMC conjectured, "I felt that by allowing the kids to 'explore' she [the teacher in the case] allowed them to raise issues and think 'incorrectly.' The more issues they raised the more confused [the teacher] became." One teacher, PDB, admitted her own difficulty in following the thinking of the students in the case: "There is no rhyme or reason given why Bob would represent one whole as nine circles." In contrast, another teacher, JPA, commented that the students' reasoning seemed "so logical." Several teachers felt that students were being confused by the language of the problem: "I think that this is one example which further reinforces the importance of the language of mathematics and using it with students often, carefully, and consistently." (MMB) Finally, one teacher, FCA, explicitly expressed her valuing of student thinking: "I think it's great that the teacher listened so well to what her students thought. I am trying to do that now."

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[3] Not all teachers were present for both meetings; there was a complete data set of "before" and "after" for only 8 of the teachers.

Questioning their role as a teacher is evidenced in the way teachers were able to place themselves in the case itself and think about what they would have done. MMB, for example, shared the tensions she felt in her own practice: "There is always the tension between what we need to provide as teachers and the need for allowing students to discover their own solutions and to hopefully internalize the concept through their own discoveries/constructions." Others were comfortable stating what they would have done in her stead: "I think the time spent should have been more on the language than on the fractions since that was where the difficulty lies" (MMB) and "Begin simple and gradually work up to the more difficult." (BCA)

Teachers' Reactions After Participating in the Case Discussion

The case discussion helped teachers see that they all faced similar struggles. Some, like MMC, identified pedagogical struggles: "After listening to the group I feel that many of us are locked into teaching the way we were taught . . . The bottom line is that we still resort to algorithms." Others, like FCA, highlighted mathematical understanding: "First of all I'm thrilled that other people spoke up to say that they also had difficulty conceptualizing the problem 1/3 of 1 1/3. So it was comforting to know that I am not out there alone."

One teacher (BAB) began to think differently about mathematics teaching and learning after the discussion: "Today's discussion helped me frame a new question. To what extent can you design/create a lesson or series of lessons that are open-ended (inquiry) based and also directed towards the discovery of a concept/skill? I realize even as I write this that this question is fraught with an error in that open-ended discovery by its nature is not directed toward any specific, predictable gain in skill....Maybe, as I look at my own teaching, there is a place for both."

Several teachers confessed that the discussion did not change their reaction to the case: "I still feel that understanding the concept of a whole and fractions and being able to work comfortably with different parts of a whole would have helped the students or anyone solving this problem–without using multiplication or division" (MMB); "I'm not sure that I feel any differently since I read over [my writing from the previous meeting]—I'm still feeling like I don't know everything I would like to know and probably never will...This lengthy discussion seems only to make my head spin but not clarify things for me." (JFA); "I guess I'm still my usual confused self." (MSA); and "I found this (discussion) to be just as confusing as reading the case." (YRC)

What We Are Learning About What Teachers Are Learning

Teaching cases are thought to be powerful because they provide situated images of teaching, help teachers to voice the issues and dilemmas of their own practice, and shape norms for collaboratively inquiring into teachers' practice. The TRN teachers identified with the images of classroom practice captured in the case, using them to think about mathematics content, student thinking, and the roles of the classroom teacher. For many, these images were an invitation to share

aspects of their thinking about their own practice — be it their own mathematical confusions, their appreciation of students' thinking, or the struggles they face over when to explore and when to explain. By reading the case, they could recognize that at least one teacher faced struggles similar to theirs; by participating in a case discussion, they learned that they indeed all shared in these dilemmas.

This was the first teaching case explored by this TRN group, and for some it was a new and confusing experience. Some were unsure of the purpose of the reading or the discussion. MSA wrote that "Since I'm at the 4th grade level we never seem to get into fraction problems of this kind, and it really wasn't something that held my interest." Others were not accustomed to thinking critically about a classroom episode: "I think my problem with this case is that we are second-guessing someone who isn't here to expand of the article. We are projecting our own ideas and needs and assumptions on someone else, finding fault and criticizing without enough knowledge as to the teacher's expectation, class, or next steps." (YRC) Learning to use the cases as an opportunity to analyze a piece of teaching—indeed, even to think about teaching as something to be analyzed—is an orientation that seems to take some time to build.

We recognize that it is important to be cautious in making strong inferences about teachers' thinking and reflection based on their journal writings, as much depends on their abilities to express themselves in writing, as well as their willingness to take the time to do so. For example, journal entries ranged from as long as 20 lines to as little as two: "I found the article intriguing. I have an excellent activity with fraction circles that I did today." (BAB) and "Discussion was great! Ideas were good! Exchange was good!" (LJA) In each case, one of these brief entries was paired with a much longer, and quite thoughtful first or second entry.

On the other hand, teachers' writing can provide important assessment information about where teachers are in their thinking about mathematics education reform. For example, teachers in this study wrote openly of their own confusions and the confusions of their students. What is particularly informative is that almost all of them felt that these confusions were something to be remedied immediately. In marked contrast, only one teacher (KOB) wrote appreciatively about the role of confusion. In her response to reading the case, she wrote: "In regard to [the teacher's] query about letting students explore before a formal lesson, I believe this is extremely important. The level of thought, frustration, and cognitive dissonance she achieved with this class could not have been attained if she had first taught them formally about multiplying two fractions when you see the word "of." In her response to the case discussion, she commented about her colleagues: "I found there was a lot of focus on how we could help the kids 'get it' rather than on how to understand their thinking, and helping them go further with it."

Many interesting questions remain about the extent to which the images conveyed in a case help teachers reconsider fundamental aspects of their practice. There are also important questions about how teachers learn to participate in the dialogue about mathematics education reform, and share these aspects of their practice with colleagues. Both of these sets of questions are important facets of helping teachers reinvent their mathematics teaching practice.

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